

THE RELATION OF THE THALAMUS TO THE PARACÆLE (LATERAL VENTRICLE).

BY BURT G. WILDER, M.D.,

Professor of Physiology, Comparative Anatomy, and Zoology, Cornell University, Ithaca, N. Y.

UPON two previous occasions—in the Cartwright Lectures for 1884 (New York Medical Journal, April 26, 1884, pp. 460-461), and in the course of discussion of my paper, "Notes on the Brain," read before this association in 1886—I called attention to the inadequacy of standard anatomical manuals with regard to the circumscription of the encephalic cavities and particularly the vagueness and inaccuracy of all figures purporting to exhibit the relation of the thalami to the strictly cerebral division of that cavity.

The objects of the present communication are these :

1. To show that my criticism is still applicable, even to publications of later date.
2. To indicate points which require further observation.
3. To suggest modifications in the modes of preparing, dissecting, describing and figuring brains which are intended to convey information respecting the subject under consideration.

The following terms may not be familiar to all, and are briefly defined.

Fimbria, the fibrous margin of the fornix, often called *corpus fimbriatum*.

Tænia, the fibrous band often called *tænia semicircularis*.

Rima, the line or area of interruption of the proper nervous parietes of the cavities for the intrusion of the plexus ; one of its margins is the *tænia*, and the other is the *fimbria*.

Rima is not synonymous with "great transverse fissure," since the latter, as well stated by Quain (II., 349), is an artificial condition produced by pulling out the plexus and tearing the membranes along the margins of the tænia and fimbria.

Ripa, any line of reflexion of the endyma upon a plexus or upon the pia. When the parts are separated, the torn or cut margin of the endyma may be traced as a more or less distinct ridge.

Ectocælian, outside the encephalic cavity ; extra ventricular.

Entocælian, located or appearing within the encephalic cavity ; intra-ventricular. Entocælian surfaces are always covered by endyma ; ectocælian surfaces are commonly covered by pia.

Striato-thalamic groove, the "sulcus limitans" of Schwalbe ; the furrow between the thalamus and the caudatum, the caudate or entocælian division of the striatum.

Plexal-groove, the "*sulcus choroideus*" of Schwalbe ; the shallow furrow on the dorsal surface of the thalamus corresponding with the margin of the fimbria and the course of the plexus.

Diacæle, the proper cavity of the diencephal or thalamic segment of the brain ; it corresponds to the "third ventricle less the aula which belongs to the prosencephal.

Prosocæle, the entire cavity of the prosencephal or fore-brain ; including the paracæles or "lateral ventricles," the portæ or "foramina of Monro," and the aula, the mesal space between them.

Paracæle, either lateral division of the prosocæle ; a right or left "lateral ventricle."

This is the only new term. It is proposed after several months consideration, as a substitute for procæle. I have used procæle at different periods, both for the entire prosencephalic cavity, and for its lateral portions ; it has not been adopted by others, and is hereby withdrawn ; *paracæle* conveys the idea of laterality and is not likely to be mistaken for *prosocæle*, the whole, of which each paracæle is a part.

I. Coming now to the three proper subjects of this paper, I have to reiterate my former criticism as to the way in which the paracœlian relations of the thalamus are represented in professedly anatomical treatises, ancient and modern.

Purely histological, embryological and physiological publications are not here included; nor those which have no figures. Mihalkorics and Hadlich distinctly contravene the current statement that the thalamus forms part of the floor of the "lateral ventricle," and the peculiar relations of the entire cerebrum to the thalami are so admirably summarized by Spitzka (*Medical Record*, July 26, 1884, p. 111) that had the article been accompanied by an illustration, one of the reasons for preparing the present paper might not have existed.

The works consulted are by the following anatomists :

Harrison Allen, Bourguery and Jacob, Burdach, Dalton, Darling and Ranney, Edinger, Gegenbauer, Gray, Huguenin, Henle, Mendel, Meynert, Quain, Sappey, Schwalbe, Viegdazyr, Weisse.

In some of these treatises the text may contain partial statements of the truth; but the very conditions which render a good figure more instructive than a description, cause illustrative imperfections to outweigh excellences of text; hence Quain and Schwalbe, for example, are to be judged not by their words, but by their more effective pictures.

Admitting, for the sake of occupying common ground, that a certain area of the dorsal surface of the thalamus is covered by endyma; that it is continuous with the caudatum, and that therefore, like that body, it enters into the composition of the paracœlian floor, none will deny an adjoining area of this same dorsal surface is as distinctly covered by pia; that it is continuous with the optic lobes, and like them wholly excluded from the encephalic cavity.

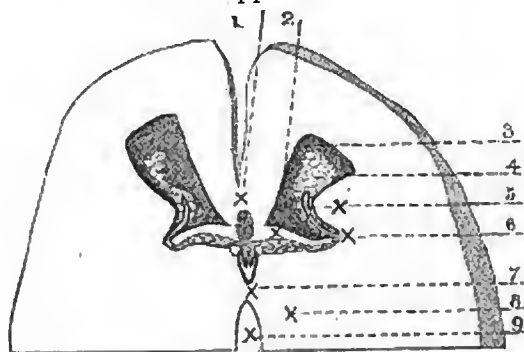
To represent the entire dorsal aspect of the thalamus as a smooth, unbroken surface is practically to affirm one or two things; either the whole is pial or ectocœlian, which would be in contravention of universal belief; or else the whole is endymal or entocœlian, which would involve not

only the optic lobes but the cerebellum and oblongata, a manifest *reductio ad absurdum*.

This, nevertheless, with perhaps a single partial exception, is what we find in the treatises above enumerated. The figures, whether representing natural surfaces or sections, fail to exhibit any lines of demarcation between entocœlian or ectocœlian areas either by a difference in texture or by raised edges to indicate where the reflected endyma had been divided. The exception referred to is Meynert's "Psychiatry," where Fig. 16 includes a line marked L, crossing the thalamus, and more distinct upon the left than upon the right; upon the explanation it is named "Linea aspera," but there is no further reference to it, and its morphological significance is not mentioned; consequently, although it probably does represent a torn edge of endyma, the figure alone would not convey any definite information. The extreme limits of misrepresentation are reached in Huguenin (Fig. 49) where the utter absence of distinction between surfaces which are said to be inside, and other surfaces which are said to be outside, can hardly fail to mislead or at least confuse the reader who is not already thoroughly grounded in correct notions as to the general morphology of the brain.

II. In the effort to prepare accurate drawings and a complete description of the paracœlian relations of the human thalamus, I have encountered certain unexpected difficulties which can be removed only by fresh preparations not now available. I confine myself therefore on the present occasion to pointing out a few matters which require further scrutiny. Among these are the existence, nature and significance of the seldom-mentioned band called by Vicq d'Azyr the *lamina cornea*; the extent of the really endymal surface of the thalamus; the relation of the pia and the endyma to the adjoining area where the latter is not adherent; the existence and extent of any paracœlian surface of the thalamus in anthropoid apes; the age at which in the human brain, the margins of the rima, the tænia and the fimbria, diverge to assume the adult condition; the accompanying figure shows that in a fœtus estimated at four

months, these parts are no farther from one another than in the lower mammals, where, even in hydrocephalus, as I showed in my first communication to the association in 1882, and as appears in the accompanying figure of a dog's brain, there is barely room for the intrusion of the plexus, and the thalamus does not appear at all within the paracœle.



TRANSECTION OF A FŒTAL BRAIN.

1. Callosum. 2. Fornix. 3. Paracœle. 4. Plexus. 5. Caudatum. 6. Rima.
7. Medicommissure. 8. Thalamus. 9. Diacœle.

1. The medicommissure is perfectly distinct and well preserved.

2. The paracœles (lateral ventricles) are higher than wide, and half their height lies dorsad of the level of the callosum.

3. The caudatum (caudate portion of the striatum) forms a marked projection of the lateral wall.

4. The fornix at this level occupies about one-third of the entire width of the cerebrum, whereas in the adult it measures not more than one-fifth, and probably more nearly one-seventh.

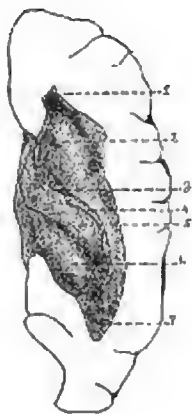
5. The fimbria, constituting the margin of the fornix, reaches the striato-thalamic groove, which demarcates the thalamus from the striatum, the diencephal from the pro-sencephal. In other words, each hemifornix is equal in width to the corresponding thalamus.

6. As corollaries to the preceding: (A) the dorsal surface of the thalamus is wholly pial, with no endymal portion as in the adult; (B) the thalamus does not, in any sense,

enter into the composition of the paracælian floor. This point is discussed at some length in my paper, 56, pp. 460, 461.

It will be seen that most of the foregoing points are more or less distinctly related to the increase in width of the entire brain, and specifically to the lateral extension of the thalami during the later stages of foetal life.

The non-appearance of the thalamus in the paracæle, and, the concomitant narrowness of the rima, are also significant, because it is the permanent condition in all other mammals with the possible exception of some other primates. Hence these facts bear upon the important question as to the nature, extent, and significance of human or primatial peculiarities.



RIGHT HEMICEREBRUM OF HYDROCEPHALUS DOG.

1. Præcornu. 2. Striatum. 3. Rima. 4. Plexus. 5. Fornix.
6. Hippocampus. 7. Postcornu.

Notwithstanding the distension which has produced a postcornu, the rima is not widened, and the thalamus is wholly excluded from the cavity.

III. Pending a full account of the matter in the future, by some other anatomist if not by myself, there are some suggestions that may properly be made in connection with it.

Brains prepared in the usual way by alcohol or chromic acid liquids are not well adapted to accurate determination of the relations and attachments of the parts concerned ; either the membranes become detached or the masses are ill-preserved, or the cavities are practically obliterated. By continuous alinjection (injection of alcohol) either into the arteries or into the cavities, or both, there are secured perfect adhesion of the membranes and plexus, firmness of the nervous tissue, and a normal separation of the cœlian parietes from one another. Instead of trying to retain the entire cerebrum, it is better to study the paracœlian relations of the thalamus upon a mass containing little more than the parts concerned, which are then less apt to be torn or broken in handling.

The investigator should bear in mind that all the relations are complicated by the over-lapping of the encephalic segments ; by the curvatures and twistings of the parts ; and by the variations in width of the rima, or interval between the tænia and the fimbria.

The anatomical teacher and writer should lay stress upon certain fundamental ideas respecting the brain ; that the organ consists of a series of segments, some of which are greatly overlapped by others ; that the neurocœle, the cavity of the neuraxis, is completely circumscribed excepting for the so-called "Foramen of Magendie ;" that the mesal cavities, ending with the diacœle, communicate with the lateral cavities, the paracœles only through the aula and the portæ or "foramina of Monro ;" that in all other mammals, excepting perhaps the anthropoids, the fornix is wide and the rima narrow, the thalamus being wholly excluded from the paracœle ; that, finally every entocœlian surface is covered by endyma, and that any interruption of endymal continuity should be distinctly indicated.

In anatomical treatises the thalami should be described and figured in connection with the other constituents of the diencephal, and only incidentally as a quasi-member of the prosencephal.

In every such treatise there should be at least one representation of a transection, in which, upon a large scale

made possible by the omission of the dorsal and lateral regions of the cerebrum, there may be shown the unbroken continuity of the paracælian endyma from the caudatum to the hippocamp, over the tænia, the plexus, and the fimbria. In a second figure, after removal of the paracælian roof, its floor should exhibit the same parts in their natural and undisturbed relations, the endymal surface uninterrupted and the pial surfaces wholly excluded from the cavities. In a third the fornix, velum and plexuses might be removed ; but then the dorsal surface of the thalamus should present two distinct sharp edges, each a " *linea aspera* " of Meynert, a *ripa* of the present writer. One of these would run parallel with the habena and demarcate the dorsal and pial surface of the thalamus from its mesal or diocælian surface ; the other would cross the dorsal surface obliquely caudolateral, and demarcate the larger pial area from that comparatively small area which is continuous with the tænia and caudatum ; this figure should also exhibit distinctly the two grooves already named, the striato-thalamic and the plexal.